

Division 600 (cont'd)

- 619 Installation of Piles
- 621 Timber Sheet Piles
- 622 Permanent Steel Sheet Piles
- 623 Prestressed Reinforced Concrete Members

619.20 Basis of Payment. The installed quantity of timber, cast-in-place concrete, steel H, and precast, pre-stressed concrete test piles and production piles will be paid for at the Contract unit price per linear foot (linear meter) for each type of pile driven. Price and payment will constitute full compensation for driving and all work associated with the installation of piles, including augering and jetting, unless noted otherwise, and re-striking piles and test piles per Subsection 619.14; for conducting and submitting the wave equation analysis; for driving additional test piles; for performing dynamic pile testing if the Contractor elects to change hammers; for driving additional piles adjacent to rejected piles; for revising footings or abutments due to additional piles; and for all equipment, labor, tools, and incidentals required to complete the work.

The labor required to cut-off piles will be considered incidental to the cost of "Installation of Piles". Price and payment will constitute full compensation for acceptably performing a pile cut-off to the details and elevation shown on the Plans; for the disposal of cut-off piles; and for all equipment, labor, tools, and incidentals required to complete the work

The quantity of driving splices constructed for Precast, Prestressed Concrete Piles will be paid for on an equivalent linear foot (linear meter) basis. Price and payment will constitute full compensation for all equipment and labor required to construct a driving splice in accordance with the Plans or details submitted by the Contractor for review and approved by the Engineer. Payment will be calculated based upon a fixed price of five hundred dollars per splice. This fixed price will be converted into an equivalent length, in linear feet (linear meters), of pile for payment purposes. The equivalent length, in linear feet (linear meters), will be based on the appropriate price bid for the piles. For example, if a driving splice is required on a production pile and the unit price bid for production piles is \$50 per foot, then the equivalent length in linear feet, to be added to that particular pile length for payment will be 10 ft ($\$500/\$50/\text{ft}=10\text{ft}$) [$\$165$ per meter, then the equivalent length, in linear meters, to be added to that particular pile length for payment will be 3 m ($\$500/\$165/\text{m} = 3 \text{ m}$)].

The cost of constructing splices for all other pile types will be considered incidental to the unit price bid for "Installation of Piles".

No payment will be made for falsework piles; for piles used in the construction of temporary wharves, platforms, and bridges, when built for the Contractor's use; for removal and replacement of rejected piles; or for any other piles not definitely shown on the Plans or listed in the Proposal tabulations.

No payment will be made for production piles and test piles not accepted, production piles and test piles improperly driven, or production piles and test piles damaged during driving.

It is understood that driving additional test piles as required by the Engineer, due to conflicting, inconclusive, or unsatisfactory original test pile data and information, shall not serve as the basis for an increase in the original Contract unit price per linear foot (linear meter) for the type of pile, nor any other extra or increased compensation other than normal increase in payment due to the extra quantity of test piles to be paid for under this Section.

Payment for furnishing all pile materials, including preservation treatment, pile shell sections, pile material used to construct splices, material used to construct build-ups, protective coating, Portland cement concrete, bar reinforcement, pre-stressing strands, and spiral reinforcement will be made under Section 618.

SECTION 620 RESERVED

SECTION 621 TIMBER SHEET PILES

621.01 Description. This work consists of the furnishing and placing of either untreated timber sheet piles or creosoted timber sheet piles.

MATERIALS.

621.02 Timber. The timber, unless otherwise noted on the Plans, or in the Special Provisions, shall consist of any species that satisfactorily withstands driving without injury. It shall be sawed with square corners and shall be free from worm holes, loose knots, wind shakes, decayed or unsound portions, or other defects which might impair its strength or tightness.

621.03 Piles. The piles shall be of the type, width, and thickness specified, prepared from sound, solid materials. They shall be drift sharpened at their lower ends so as to wedge the adjacent piles tightly together.

621.04 Preservative Treatment of Sheet Piling. Preservative treatment shall be the same as specified for piles under Section 618.

621.05 Hardware. Hardware shall conform with the requirements of Subsection 601.07.

CONSTRUCTION METHODS.

621.06 Construction Materials. Timber sheet piles may be driven or jetted into place as directed. Sheet piles shall be so driven as to form a permanent, tight structure. After piles are in final position and have attained full bearing, the tops shall be cut off to a straight line at the elevation shown on the Plans, or as required.

Sheet pile cut-offs shall become the property of the Contractor, be removed from the Project site, and be disposed of in a manner that meets with the Engineer's approval.

Where shown on the Plans or directed, the tops of sheet pile walls shall be braced and aligned by means of timber wales. Wales shall be lapped and jointed at splices and corners and shall be solidly bolted or fastened together. The construction of wales shall conform, where applicable, with the provisions of Section 601.

621.07 Method of Measurement. The quantity of timber sheet piles will be measured as the actual number of thousands of feet board measure (cubic meters) of sheet piles, driven and accepted. No measurement will be made for material cut off.

The number of thousands of feet board measure (cubic meters) of timber wale construction will be measured in accordance with Section 601.

621.08 Basis of Payment. The quantity of timber sheet piles, including timber wales where required, will be paid for at the Contract unit price per thousand feet board measure (cubic meter).

Price and payment will constitute full compensation for furnishing, driving, and cutting off the sheet piles; for timber wale construction, including hardware, where required; and for all labor, tools, equipment, and incidentals required to complete the work.

No payment or allowance will be made for sheet pile cut-offs.

SECTION 622 PERMANENT STEEL SHEET PILES

622.01 Description. This work consists of furnishing and placing untreated steel sheet piles.

622.02 Materials. Steel sheet piles shall be manufactured steel conforming to the requirements of AASHTO M 202/M 202M unless otherwise shown on the Plans.

All steel piles shall be straight and true at the time of driving. Pile camber and sweep shall be within the permissible mill tolerances.

622.03 Construction Methods. Construction shall not begin on the steel sheet pile bulkhead wall until all muck excavation in the immediate and adjacent area is completed and Borrow Type B is placed to the elevations shown on the Plans.

Sheet pile units shall be placed to full penetration and shall attain firm bearing in their final position. Jetting is prohibited. Sheet piles shall be placed to form a permanent tight structure and shall be cut off at, or driven to, the elevation shown on the Plans, or as directed. All pile cut-off material shall become the Contractor's property and shall be removed from the Project site.

622.04 Method of Measurement. The quantity of steel sheet piles will be measured in the field by determining the actual number of square feet (square meters) of steel sheet piles placed and accepted, after cut-off. The cut-off portion of piles will not be measured for payment. The horizontal measurement of the completed installation shall be taken on a straight line between interlocks (the nominal or published width), not around the perimeter of the sheet pile units. The vertical measurement shall be taken from the tip elevation to the cut-off, or top elevation.

622.05 Basis of Payment. The quantity of steel sheet piles will be paid for at the Contract unit price per square foot (square meter). Price and payment will constitute full compensation for furnishing, placing, and cutting off the sheet piles; and for all labor, tools, equipment, and incidentals required to complete the work.

SECTION 623 PRE-STRESSED REINFORCED CONCRETE MEMBERS

623.01 Description. This work consists of furnishing and erecting pre-stressed, precast, reinforced concrete members and accessories, on substructure units.

This work also includes furnishing and installing bearing pads and materials, dowels, tie rods, nuts, plates, joints and joint materials, scuppers, and all other parts and materials required to complete the work

623.02 Strand. Strands shall be as shown on the Plans.

623.03 Wire. Wire shall be as shown on the Plans. The Contractor may propose the use of superior materials to the Department for approval.

623.04 Bar Reinforcement. Bar reinforcement shall conform to the requirements of Section 824.

623.05 Portland Cement Concrete. Portland cement concrete shall conform to the requirements of Section 812. The Contractor shall submit a mix design for the concrete to be used in pre-stressed members to the Department for approval. In addition, the total chloride content of the concrete mixture shall not exceed 0.06% by weight of cement. The mix design shall follow ACI design procedures and shall include the following:

Cement:	Type I, II, or III, 7 bags/yd; (9.2 bags/m ³)
Air Content:	5 " 2%
Admixtures:	AASHTO M 194
Required Strength, f_{cr} :	Sufficient to ensure a minimum 28-day design strength of 5,000 psi (35 MPa) (ACI 214 evaluation)

The required test cylinder strength of the concrete at the time of transfer of the tensioning load from strand to concrete (release of pre-stress) shall be not less than 4,000 psi (25 MPa).

Cylinders shall be initially cured under the same curing conditions as the members. A total of six test cylinders shall be cast for each member and tested as follows:

- Two cylinders (release cylinders) shall be tested to determine when transfer of the tensioning load may be permitted.
- Three cylinders shall be tested at 28 days.
- One cylinder shall be held in reserve or tested at the time of shipping, if necessary.

After the release cylinders have been tested, the remainder of the test cylinders shall be moist cured.

623.06 Bearing Materials. Elastomeric bearings shall include plain bearings, consisting of elastomer only, and laminated bearings consisting of layers of elastomer restrained at their interfaces by bonded laminates, each type being of the size indicated on the Plans.

The elastomer portion of the elastomeric compound shall be 100% virgin natural polyisoprene (natural rubber) conforming to the requirements of Table 623-A, or 100% virgin chloroprene (neoprene) conforming to the requirements of Table 623-B, as specified in the Contract. Compounds of nominal hardness between the values shown in the tables may be used and the test requirements interpolated. If test specimens are cut from the finished product, a 10% variation in "Physical Properties" will be allowed.

Laminates shall be rolled mild steel sheets conforming to AASHTO M 183/M 183M unless otherwise specified by the Engineer.

Bearings shall be manufactured according to the following requirements. Plain bearings may be molded individually, cut from previously molded strips or slabs, or extruded and cut to length. Cut edges shall be at least as smooth as specified for an ANSI 250 (6.3 μ m) finish. Unless otherwise shown on the Plans, all components of a laminated bearing shall be molded together into an integral unit, and all edges of the nonelastic laminations shall be covered by a minimum of 1/8" (3 mm) of elastomer, except at laminate restraining devices and around holes that will be entirely closed on the finished structure.

Bearing tolerances shall conform to the following requirements. Flash tolerance, finish and appearance shall meet the requirements of the latest edition of the Rubber Handbook as published by the Rubber Manufacturers Association, Inc., RMA F3 and T.063 for molded bearings and RMA F2 for extruded bearings. For both plain and laminated bearings, the permissible variation from the dimensions and configuration required by the Plans and this Section shall be as follows:

a. Overall Vertical Dimensions:		
Average Total Thickness 13" (32 mm) or less		-0, +1/8" (-0, +3 mm)
Average Total Thickness over 13" (32 mm)		-0, +1/4" (-0, +6 mm)
b. Overall Horizontal Dimension		
36" (900 mm) and less		-0, +3" (-0, +6 mm)
over 36" (900 mm)		-0, +2" (-0, +13 mm)
c. Thickness of Individual Layers Elastomer (laminated bearing only)		
		1/8" (3 mm)
d. Variation from a plane parallel to the theoretical surface (as determined by measurements at the edges of the bearings):		
Top		1/8" (3 mm)
Sides		1/4" (6 mm)
Individual Non-Elastic Laminates		1/8" (3 mm)
e. Position of Exposed Connection Members		1/8" (3 mm)
f. Edge Cover of Embedded Laminates or		
g. Connection Members		-0, +1/8" (-0, +3 mm)
h. Size of Holes, Slots, or Inserts		1/8" (3 mm)
i. Position of Holes, Slots, or Inserts		1/8" (3 mm)

Whenever practical, the mechanical properties of the finished bearing shall be verified by laboratory test.

The following values shall be met under laboratory testing conditions of full size bearings:

- a. Compressive strain of any layer of an elastomeric bearing shall not exceed 7% at 800 psi (5.5 MPa) average unit pressure or at the design dead load plus live load pressure if so indicated on the Plans.
- b. The shear resistance of the bearing shall not exceed: 30 psi (205 kPa) for 50 durometer, 40 psi (275 kPa) for 60 durometer, or 50 psi (345 kPa) for 70 durometer Table 623-A compounds; and shall not exceed 50 psi (345 kPa) for 50 durometer, 75 psi (515 kPa) for 60 durometer, or 110 psi (760 kPa) for 70 durometer Table 623-B compounds at 25% strain of the total effective rubber thickness after an extended four-day ambient temperature of -20 °F (-29 °C).

Table 623-A

<i>ASTM</i>	<i>Physical Properties</i>	<i>50</i>	<i>60</i>	<i>70</i>
<i>Standard</i>		<i>Durometer</i>	<i>Durometer</i>	<i>Durometer</i>
D 2240	Hardness	50 " 5	60 " 5	70 " 5
D 412	Tensile Strength, minimum psi (MPa)	2500 (17)	2500 (17)	2500 (17)
	Ultimate elongation, minimum %	450	400	300
<i>Heat Resistance</i>				
D 573	Change in durometer hardness,	+10	+10	+10
70 hours	maximum points			
at 158 °F	Change in tensile strength,	-25	-25	-25
	maximum %			
	Change in ultimate elongation,	-25	-25	-25
	maximum %			
<i>Compression Set</i>				
D 395	22 hours at 158 EF (70 EC), maximum %	25	25	25
Method B				
<i>Ozone</i>				
D 1149	25 pphm ozone in air by volume, 20%	No	No	No
	strain, 100"2 °F (38 " 1 °C), 48 hours mounting procedure D 518, Procedure A	Cracks	Cracks	Cracks
<i>Adhesion</i>				
D 429 B	Bond made during vulcanization, lb/in (kN/m)	40 (7.0)	40 (7.0)	40 (7.0)
<i>Low Temperature Test</i>				
D 746	Brittleness at -40 °F (-40 °C)	No	No	No
Procedure B		Failure	Failure	Failure

Table 623-B

<i>ASTM Standard</i>	<i>Physical Properties</i>	<i>50 Durometer</i>	<i>60 Durometer</i>	<i>70 Durometer</i>
D 2240	Hardness	50 " 5	60 " 5	70 " 5
D 412	Tensile Strength, minimum psi (MPa)	2500 (17)	2500 (17)	2500 (17)
	Ultimate elongation, minimum %	450	350	300
<i>Heat Resistance</i>				
D 573	Change in durometer hardness,	+15	+15	+15
70 hours	maximum points			
at 212 °F (100 °C)	Change in tensile strength,	-15	-15	-15
	maximum %			
	Change in ultimate elongation,	-40	-40	-40
	maximum %			
<i>Compression Set</i>				
D 395	22 hours at 212 EF (100 °C),	35	35	35
Method B	maximum %			
<i>Ozone</i>				
D 1149	100 pphm ozone in air by volume, 20%	No	No	No
	strain, 100 " 2 °F (38 " 1 °C), 100 hours	Cracks	Cracks	Cracks
	mounting procedure D 518, Procedure A			
<i>Adhesion</i>				
D 429 B	Bond made during vulcanization, lb/in (kN/m)	40 (7.0)	40 (7.0)	40 (7.0)
<i>Low Temperature Test</i>				
D 746	Brittleness at -40 °F (-40 °C)	No	No	No
Procedure B		Failure	Failure	Failure

623.07 Non-Shrink Grout. Non-shrink grout shall be composed of one sack of cement, 105 lb (47.6 kg) of sand, and 100 lb (45.4 kg) of approved non-shrink admixture.

623.08 Structural Steel. Structural steel shall conform to the requirements of Section 605, as applicable.

623.09 Protective Coating. The Contractor shall apply an epoxy coal-tar protection coating system to the surfaces indicated on the Plans. The epoxy coal-tar application shall consist of grinding and preparing the bridge deck surfaces, applying the epoxy coal-tar resin to the prepared surfaces, and coating the epoxy with sand as described herein or as directed by the Engineer.

DESIGN AND MANUFACTURE OF PRE-STRESSED MEMBERS.

623.10 Plans and Alternate Designs. The Plans show general details and information, pertaining to the pre-stressed, precast, concrete members, that serve as an indication of the type of construction acceptable. If the Contractor proposes an alternate design, a complete set of detailed shop drawings, with supporting design computations for the pre-stressed members to be furnished, shall be submitted in accordance with Subsection 105.04 for approval prior to any work.

The manufacture of pre-stressed members shall not proceed until the final shop drawings have been approved.

623.11 Design Criteria. The design of the pre-stressed, precast, reinforced concrete members shall meet the requirements of Section 6 of the AASHTO Standard Specifications for Highway Bridges.

The design load shall be HS 20-44.

For compressive strength of concrete at 28 days, f'_{N_c} shall be 5,000 psi (35 MPa) minimum.

For compressive strength of concrete at time of initial pre-stress, f'_{N_c} shall be 4,000 psi (25 MPa) minimum.

623.12 General Manufacturing Requirements. All plants manufacturing pre-stressed reinforced concrete members for work under this Contract shall be inspected and approved before manufacture of the members may be started. Only PCI certified plants, or plants which have been inspected and approved by the Department, will be permitted to manufacture pre-stressed primary load carrying members.

All materials, equipment, processes of manufacture, and the finished members, including handling, storage, and transportation, shall be subject to inspection and approval. Any defective construction, which may adversely affect the strength of a member or its performance in the bridge deck, shall be cause for rejection.

Permissible construction tolerances shall be in accordance with those recommended in the PCI Manual for Quality Control for Plants and Production of Precast Prestressed Concrete Products. Tolerances for reinforcing bar cover shall be from -1/2" to 1/2" (-6 to +13 mm).

623.13 Forms. Forms and centering shall be made and maintained, during their use, true to the shapes and dimensions shown on the approved drawings

Unless otherwise provided, only metal forms shall be used. The forms shall be well constructed, carefully aligned, substantial, firm, and securely braced and fastened together. The forms shall be sufficiently tight to prevent leakage of mortar and strong enough to withstand the action of mechanical vibrators.

Form ties shall be either the threaded type or the snap-off type. No form wires or metal pieces shall be left at the surface of the finished concrete. Corners and angles shall be mitered or rounded.

Joints between panel forms shall be made smooth and tight.

623.14 Reinforcement and Pre-tensioning Strands. Bar reinforcement and pre-tensioning strands shall be free of frost, dirt, oil, paint, mill scale, corrosion, or any foreign material that may prevent a bond between the steel and concrete. If an

anti-bonding agent is used on the forms, every precaution shall be taken to protect the reinforcement and the pre-tensioning strands from being coated by the anti-bonding agent.

Pre-tensioning strands, reinforcement, and other embedded fixtures shall be accurately placed as indicated on the drawings and shall be maintained in their correct position during the manufacture of the members.

623.15 Pre-tensioning. The amount of stress to be given each cable or strand shall be shown on the approved working drawings.

All cables or strands to be pre-stressed in a group shall be brought to a uniform initial tension prior to being given their full pre-tensioning. This uniform initial tension shall be approximately 500 lb (2.2 kN) per strand and shall be measured by a dynamometer or other approved means so that the initial tension can be used as a check against elongations computed and measured. After this initial tensioning, the group of strands shall be stressed until the required elongation and jacking pressure is attained. The stress induced in the cables or strands shall be measured both by jacking gages and by elongations of the cables or strands. The calculated stress based on the elongation should closely match the gage reading.

All jacks shall be equipped with accurate and calibrated gages for registering jacking pressures. Means shall be provided for measuring the elongation of the pre-stressing strands to at least the nearest 1/32" (1 mm).

The Contractor shall be required to furnish the Department with satisfactory, accredited proof that all jacking equipment and gages to be used in the manufacture of the pre-stressed members have been calibrated by a reputable testing laboratory.

The interpretations and analysis of the elongations and jacking pressures shall consider and allow for all possible slippage or relaxation of the anchorage.

If there is a discrepancy of as much as 10% between the stresses determined by the jacking pressure and the elongation measurement, the entire operation shall be carefully checked and the source of error determined, before proceeding. After the cables or strands are stressed in accordance with the plan requirements and this Subsection, and all other reinforcing is in place, the concrete shall be placed in the form. The temperature of the concrete shall be between 50 and 85 °F (10 and 29 °C). Cable or strand stresses shall be maintained between anchorages until the concrete has reached a minimum compressive strength of 4,000 psi (25 MPa) and the process of transferring the pre-stress to the member has begun.

Members shall be steam cured under a suitable enclosure to contain the live steam and minimize moisture and heat losses. The initial application of the steam shall be from four to six hours after the final placement of concrete to allow the initial set of the concrete to take place. The steam shall be at 100% relative humidity to prevent loss of moisture and to provide excess moisture for proper hydration of the cement. Application of the steam shall not be directly on the concrete. During application of the steam, the ambient air temperature shall increase at a rate not to exceed 40 °F (22 °C) per hour until a maximum temperature of from 140 to 160 °F (60 to 71 °C) is reached. The maximum temperature shall be held until the concrete has reached the desired release strength. In discontinuing the steam, the ambient air temperature shall not decrease at a rate exceeding 40 °F (22 °C) per hour until a temperature has been reached that is about 20 °F (11 °C) above the temperature of the air to which the concrete will be exposed. The concrete shall not be exposed to temperatures below freezing for six days after casting. Recording charts of steam temperature shall be maintained.

The de-tensioning shall be done immediately following the curing period while the concrete is still warm and moist. If allowed to dry and/or cool prior to de-tensioning, dimensional changes take place which may cause cracking or undesirable stresses in the concrete.

In all de-tensioning operations, the pre-stressing forces must be kept nearly symmetrical about the vertical axis of the member. The de-tensioning must be applied in a manner that will minimize sudden or shock loading. Maximum eccentricity about the vertical axis shall be limited to one strand.

Forms, ties, inserts, holddowns, or other devices that would restrict longitudinal movement of the members along the bed shall be removed or loosened. Alternate de-tensioning shall be performed in such manner and sequence that longitudinal movement is precluded.

After completing the release of the pre-stresses, the strands shall be cut flush with the ends of the member and painted with either an approved bitumastic compound or waterproofing compound.

623.16 Production. The manufacturing process shall provide uniform production of dense, high grade concrete for all parts of the pre-stressed members under all working and weather conditions. The operations of mixing, placing, finishing, and curing shall be subject to inspection and approval.

623.17 Handling, Storage, and Shipping. Prestressed members may be handled immediately after curing and de-tensioning of the of strands or cables. Members shall not be shipped until at least the minimum 28-day compressive strength has been attained but in no case less than three days after the placing of concrete in the forms. Members shall be handled using the pick-up points provided especially for this purpose. The members shall be maintained in a horizontal position (as when formed on the casting bed) at all times during handling, moving, storing, and shipping.

Members damaged by improper storing, handling, transporting, or erecting shall become the property of and be replaced by the Contractor.

Members will be inspected at the Project site for possible shipping damage and for verification that the member meets all dimensional requirements required by the Contract.

The Contractor shall follow the manufacturer's recommended procedures for handling and placing the precast members during the entire process of transporting, unloading, and installing the members.

623.18 Grouting Between Prestressed Members. After the deck members have been placed and fastened together with tie rods and the end anchor dowels have been placed, the longitudinal joints between adjacent members shall be filled with a non-shrink grout.

Immediately prior to filling the joints, the keyways shall be cleaned of all debris, oil, grease, and other material that may prevent effective bonding. After cleaning, the keyways shall be thoroughly soaked with water and tightly caulked with an approved material, below the bottom of the shear key to avoid grout leaks. The caulking material shall not project more than 2" (13 mm) into the shear key area. In cold weather, the concrete against which the grout will be placed must be frost-free deck for at least 24 hours after the grout has been placed or, preferably, not until the end of the curing period.

623.19 Scuppers. The Contractor shall furnish and install scuppers of the material and at the locations shown on the Plans or as directed.

623.20 Method of Measurement. The quantity of pre-stressed, precast, reinforced concrete members, placed and accepted, will not be measured.

623.21 Basis of Payment. The quantity of pre-stressed reinforced concrete members placed will be paid for at the Contract lump sum price. Price and payment will constitute full compensation for furnishing and placing all materials, including the removal and replacement of all pre-stressed members rejected due to defective construction or improper storing, handling, or transporting; and for all equipment, tools, labor, and incidentals required to complete the work.